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ABSTRACT

The relative effectiveness of three types of elaboration (sentences, semantic paragraphs, and syntactic paragraphs) on paired associate learning in 75 educable mentally retarded Ss was tested under list lengths of eight, 12, 16 and 24 pairs. For all lists except the eight pair list, the elaborators were found to be equally and highly effective as mediators for paired associate learning, with Ss responding correctly to an average of at least 60% of the items on the first trial in all treatment conditions. At the eight pair level, the semantic paragraph group was found to be superior in learning to the sentence group. Following their performance on the paired associate task, Ss were asked to recall the original form of the elaborators given during training. Data indicated that the large percentage of pairs correctly recalled during the first acquisition trial at all list lengths was related to the ability of the S to store the meaning of the elaborators rather than the ability to recall the exact form of the elaborator. Reviewed was literature on verbal mediation in the mentally retarded, verbal elaboration and paired associate learning, and extensions of verbal elaboration research. Stimulus response pairs and their verbal elaborators were presented in an appendix. (Author/GW)

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MENTAL ELABORATION AND THE EXTENSION OF MEDIATIONAL RESEARCH: LIST LENGTH EFFECTS OF VERBAL PHENOMENA IN THE MENTALLY RETARDED [1]

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Abstract

Following a review of the relevant literature on mediational and elaborated verbal processes in retarded individuals, a study was conducted to extend Turnure's verbal elaboration research. With educable mentally retarded children as subjects, the relative effectiveness of three elaborator forms (Sentences, Semantic Paragraphs, and Syntactic Paragraphs) on paired-associate learning was tested under list lengths of 8, 12, and 16 pairs in the main study, and 24 pairs in a supplementary study. The hypothesis that differences between the effects of the various elaboration conditions would become evident as list length increased was not supported. Only at the eight pair level was a significant difference in treatments found, with the Semantic Paragraph group being superior in learning to the Sentence group, thus partially replicating previous research on this problem. At all other list lengths, the elaborators were equally and highly effective as mediators for paired-associate learning, with subjects responding correctly to an average of at least 60% of the items on the first trial in all treatment conditions.

Analysis of the error data suggested that pairs presented in interrogative elaborators were missed significantly more often than those presented in either declarative or imperative sentence-forms. Response latency measures, recorded in order

to determine if subjects in different elaboration conditions might take differential times to respond, revealed that latencies for subjects in all conditions were similar. Following their performance on the paired-associate task, a number of subjects were asked to recall the original form of the elaborators given during training. This was done to allow for the investigation of Sachs' hypothesis that it is the "meaning" of an elaborator which is stored rather than the elaborator itself. Scoring of recall data suggested that the large percentage of pairs correctly recalled during the first acquisition trial at all list lengths was related to the ability of the subject to store the meaning of the elaborators given during training, rather than to his ability to recall the exact form of the elaborator.

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MENTAL ELABORATION AND THE EXTENSION OF MEDIATIONAL RESEARCH: LIST LENGTH EFFECTS ON VERBAL PHENOMENA IN THE MENTALLY RETARDED[1]

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Verbal learning tasks have achieved wide importance in the study of learning processes in retarded as well as normal individuals. In particular, paired-associate learning has received considerable attention, both because it is frequently viewed as being representative of what people do when they learn verbal materials, and because it is a model example of the associative processes (Deese & Hulse, 1967, p.291). Paired-associate learning research with retarded individuals has frequently been concerned with mediational processes, i.e., with the ability of retardates to use verbal mediators to facilitate learning. Although much of the research seems to be based on an implicit assumption that retardates are in some way deficient in mediational ability (Goulet, 1968, p.116), it appears that the finding of a mediational deficit in these individuals may hold true only for certain tasks.

A recent extension of mediational research, known as mental elaboration research, appears to support this hypothesis. When items are presented to retarded individuals in a verbal elaborator (i.e., a verbal context such as a sentence), paired-associate

learning is greatly facilitated. The apparently occurs because the retardate is able to use the elaborator to "mediate" an association between the paired items. The ability of such a verbal context to facilitate paired-associate learning varies with such factors as its meaningfulness and its syntactic structure (Rohwer, 1966). In fact, it has recently been demonstrated that the form of the elaborator (sentence vs. paragraph) affects the amount of facilitation which results from the use of a verbal elaborator (Tunrure, 1971).

It thus appears that when verbal elaboration research is used to investigate mediational processes in retarded individuals, a deficit does not exist. Previous studies have investigated verbal elaboration phenomena at various levels of difficulty, but there has been no attempt to relate the effectiveness of an elaborator to the difficulty of the task. The present research proposes to do just that. Specifically, it is an attempt to assess the relative value of two types of verbal elaborators (sentences and paragraphs) in facilitating paired-associate learning in lists of increasing length.

Literature Review

Mediational processes have received a great deal of attention in the past thirty years. As Jenkins (1963) indicates, a plot of the number of research endeavors and theoretical papers concerned with mediation over this period of three decades would reveal a rapidly accelerating curve. Generally,

the concern in investigations of mediation has been to determine the ways in which various intervening items (verbal, visual, motor, etc.) can bridge the gap between two apparently unrelated items. The principle of mediation has most commonly been interpreted as asserting that associations are formed between two apparently unrelated elements, say A and C, because they are both associated in some way with a third element B (Deese & Hulse, 1967, p.315). Three basic paired-associate paradigms have been used in order to study these mediated associations: the forward chaining paradigm (A-B, B-C, A-C), perhaps the most extensively studied, the stimulus equivalence paradigm (A-B, C-B, A-C), and the response equivalence paradigm (B-A, B-C, A-C). Generally, it has been found that in all paradigms subjects show positive transfer to the third stage list (see Horton & Kjeldergaard, 1961). The facilitation resulting from mediational processes, whether the mediated association is inferred or experimentally established, has been demonstrated in a wide variety of situations, with numberous tasks, using several indices of facilitation.

In a summary of mediation research, Jenkins (1963) indicates that the proposition that mediation effects can be found has been firmly established. Initial research in this area, however, nearly always involved the use of college students as subjects, and the facilitation that has been found is thus most firmly established for adults performing some

type of paired-associate task. The need for future research, as Jenkins (1963) sees it, is to look for ways to reinforce both mediational responses and the mediating activity itself, and to explore the capacity of various tasks and situations to elicit associative arousal and the consequent mediational phenomena. This seems to be a particularly important goal for research with the mentally retarded.

Verbal Mediation in the Mentally Retarded

It has frequently been suggested that there exists a mediational deficiency in retarded individuals. The failure to find differences in reversal - nonreversal discrimination in retardates (Sanders, Ross, & Heal, 1965) has sometimes been taken as support for Luria's hypothesis that retarded individuals are characterized by an inability to utilize verbal mediation. He has suggested that retardates perform poorly in a number of tasks because of the lack of association between the first (verbal) and second (motor) signal systems (Luria, 1957). Similarly, the poorer performance of retardates in certain paired-associate learning tasks, when compared to MA controls, has sometimes been regarded as a demonstration of the retardate's inefficient use of verbal mediators (Lipman, 1963). These types of hypotheses and findings have provided the major reasons for the initiation of investigations into the mediational processes

of retarded individuals in various paired-associate learning tasks.

Few investigations of mediation in retarded individuals have employed the traditional paired-associate task used with college students. Furthermore, the results of these few studies have been equivocal. Berkson and Cantor (1960) attempted to compare mediation in matched CA groups of retarded children and normal school children. Using the A-B, B-C, A-C mediation paradigm and an X-B, B-C, A-C control paradigm, they found that both the normal and the retarded mediation groups were significantly superior to the control groups in speed and accuracy of learning the A-C list. This finding was taken as support for the hypothesis that both retarded and normal subjects are capable of mediation behavior. Berkson and Cantor found no evidence for a relationship between IQ and the degree of mediational facilitation. Numerous design problems, however, obscure these results. As Berkson and Cantor recognize, the difference between the mediation and control conditions might be attributed to the fact that subjects in the mediation group had been exposed to the A items in the first list while those in the control condition had not. Furthermore, the finding of no difference between the retarded and normal groups could be due to over-learning effects which might have resulted from criterion of five successive correct list anticipations that Berkson and Cantor employed. Because of these problems, the results are far from conclusive.

In an experiment designed to correct these problems and extend the results of Berkson and Cantor, Borkowski and Johnson (1968) used an A-B, D-C, A-C control paradigm and required that the lists be learned only to a criterion of two perfect recitations (not necessarily consecutive). Using A-B and B-C stages made up of highly associated picture pairs (A:Boy - B:Wagon, B:Wagon - C:Red), they found that retarded children performed as well as a matched MA group of normal children during the A-C stage. In the control condition, however, where mediational links between A and C were not provided, the performance of normals was superior to that of the retarded group. Borkowski and Johnson thus conclude that their results support the conclusions reached by Berkson and Cantor.

In a similar attempt to overcome some of the methodological problems of the Berkson and Cantor study, Penney, Seim, and Peters (1968) found effects which do not appear to agree with those obtained by Borkowski and Johnson. When using the anticipation interval employed by Borkowski and Johnson (six seconds), Penney et al. found that institutionalized mentally retarded children were mediationally deficient relative to normal children of the same mental age. With a twelve second anticipation interval, however, mediation in retarded subjects was enhanced. It was hypothesized that the mediational processes in the retarded individual are slower than the mediational processes in the normal child. It should be noted that unlike

the Borkowski and Johnson picture-pairs, those used by Penney, et al. in the A-B and B-C stages were not highly associated (A:Cup - B:Ball, B:Ball - C:Shoe). Their task thus appears to be more difficult than that used by Borkowski and Johnson.

A recent study by Gallagher (1969) has also reported a mediational deficiency in retarded subjects. Using an oral-aural procedure, the study attempted to investigate the influence of free association strength as an inferred mediator between word pairs (A:Table - B:Chair, B:Chair - C:Sit). Inferred mediators were used in order to control for the over-learning effects which Gallagher claims are present in both the study by Berkson and Cantor and the study by Borkowski and Johnson. Like Penney et al., Gallagher did not find the facilitation found by Berkson and Cantor and Borkowski and Johnson. He found that retarded subjects made significantly more errors than normal subjects over all levels of free association strength in the mediation condition. Gallagher suggests that this may be because the mediators are not as available to the retarded subjects. Any conclusion from this study must be tentative however because, as Gallagher notes, retardates do not perform as well as matched MA normals in the paired-associate learning of normatively associated word pairs when an oral - aural procedure is used.

As these studies indicate, the finding of mediational processes in the retarded individual, when put in a traditional

three-stage chaining paradigm, is far from clear. These studies do, however, confirm the importance of a point made by Jenkins (1963): Various tasks appear to differ in their capacity to elicit associative arousal. Jenkins suggests that is is not only necessary to show that mediation phenomena may be observed under a few prescribed conditions, but also to investigate the conditions governing its occurrence. Furthermore, research should attempt to reinforce mediational responses and mediating activity, and to explore the natural capacity of various tasks and situations to elicit mediational phenomena. This type of mediational research, the investigation of tasks used to promote mediation, has been pursued in an area frequently referred to as "mental elaboration."

Verbal Elaboration and Paired-Associate Learning

The term "mental elaboration" has generally been used to allude to some form of "mental" activity which organizes and perhaps adds details to some piece of information. This activity may be visual (e.g., pictures, images) or verbal. Verbal elaboration has frequently been considered to be a form of mediation, when "mediation" is not defined in a strict sense. As Rohwer (1970) notes, the investigation of mental

elaboration might be considered to be an examination of positive transfer effects which are a function of the context in which items to be associated are initially presented. The "mediator" is thus the context in which the items to be associated occur, rather than some third element which is related to the two items. Epstein, Rock, and Zuckerman (1960) first found that the performance of college students who learned pairs of nouns in the context of three-word phrases in which the middle word was an intelligible connective was superior to that of subjects who learned the same pairs as parts of three-word phrases in which the middle word did not reasonably connect the two members of the pairs. They concluded that the former condition was superior because it encouraged the formation of conceptual units. Similar findings were obtained by Epstein et al. when subjects were provided with a visual compound -- a picture portraying the stimulus and response items in some type of meaningful interaction. As a result of these findings, numerous investigators have gone on to demonstrate that the learning of associations between pairs of words can be greatly enhanced by providing subjects with a verbal context -- phrases or sentences which combine the nominally unrelated stimulus and response items.

Two major types of verbal elaboration methods have been studied -- self-activated elaboration and elaboration which is

manipulated by instructions (calling for either subject-generated elaborators or experimenter-generated elaborators). Studies have generally used instructions to manipulate the occurrence of elaboration. In most investigations of sentential elaboration, the experimenter has either provided the subject with a sentence which combines the members of a pair, or has instructed the subject to make up a sentence combining the paired items.

The remarkable facilitation of paired-associate learning resulting from the presentation of items in a verbal context has also been demonstrated in retarded individuals. Initial investigations of sentential facilitation in normal children and retarded individuals were undertaken by Jensen and Rohwer (1963a, 1963b, 1965). They found that for mentally retarded adults and normal second-, fourth-, sixth-, and tenth-grade children, instructions to repeat a sentence containing the names of the two members in a pair produced marked facilitation over a condition where subjects were simply instructed to name the two pictures. No significant facilitation was found for normal kindergarten and twelfth-grade children. Jensen (1966) has noted that college students learning a list of paired-associates frequently report that they make up verbal mediators to link the paired items (cf. Martin, Boersma, & Cox, 1965; Montague & Wearing, 1967). Jensen thus suggests that preschool children and adolescents benefit least from mediation instruc-

tions, the former because they may not be able to profit from verbal cues and the latter because they may, like college students, spontaneously mediate (i.e., elaborate).

The dramatically facilitating effect of providing retarded individuals with elaborators led Jensen and Rohwer (1963a) to hypothesize that the retarded subjects they tested were unable to spontaneously use verbal mediators in paired-associate learning. With regard to this, Martin (1967) has shown that although retarded individuals report elaborating fewer paired-associates in a traditional paired-associate task, when verbal elaborators are given to them, they perform as well as normal children. Consistent with this is a recent finding by MacMillan (1970). He reports that although the educable mentally retarded children he tested appeared to use verbal elaborators presented to them, when required to generate their own sentences, they did not seem to be able to use these sentences as mediators. As a consequence of these types of findings, numerous investigations have looked at the facilitation resulting from the use of verbal elaborators provided by the experimenter to mediate associations between two items.

The marked facilitory effect on acquisition of providing the subject with sentences in which the noun pairs to be learned are embedded, has been repeatedly demonstrated. It has been shown that whereas retarded individuals may require a large number of repetitions to learn a traditional list of paired-

associates, when they are given sentences combining the pairs on only the first trial, subsequent learning of the pairs is almost immediate (Jensen, 1966). It thus appears that by supplying an elaborator to the subject, a task is provided which elicits mediational processes in retarded individuals. In accordance with Jenkins' (1963) ideas, this task should be ideal for further investigation of mediational processes within the retarded individual.

Extensions of Verbal Elaboration Research

The marked facilitation of paired-associate learning resulting from mental elaboration has recently been demonstrated in the traditional three-stage mediation paradigm (Milgram, 1968). Milgram had retarded subjects learn paired-associate lists of the A-B, B-C, A-C paradigm. During an initial presentation trial of the B-C list, experimental subjects were required to recite sentences containing the stimulus and response terms of each pair. Whether the sentence was meaningful or nonsensical, these subjects learned the B-C pairs in fewer trails than did those subjects learning B-C pairs in the customary manner. In addition, the use of verbal elaboration to learn the B-C pairs resulted in significantly greater mediational facilitation in learning A-C. This extension of the facilitory effects of verbal elaboration to a traditional three-list mediational paradigm suggests that the

use of verbal elaboration may have other important extensions.

One possible extension of verbal elaboration phenomenon has been suggested by the work of Davidson (1964). He attempted to evaluate the differential facilitation resulting from increasingly elaborated experimental conditions in normal second-graders. Davidson found that a condition in which the link between two items was formed by a single preposition was as effective as one in which two pictures were related by a sentence, and even one in which the pictures actually depicted the relationship given in the sentences. It must be noted, however, that the lack of differences between the experimental groups could be attributed to a ceiling effect. Subjects performed extremely well under all of the elaboration conditions.

A recent investigation by Turnure and Walsh (1971) indicates that varied levels of elaboration do have differential facilitative effects on paired-associate learning. They employed verbal materials that extended the verbal context to one in which the stimuli to be associated were embedded within two-sentence paragraphs. It was found that retarded children reciting the paragraphs learned four paired-associates in significantly fewer trails than those who recited simple sentences, and they, in turn, required significantly fewer trials than those subjects simply required to label pictures. In fact, children in the paragraph condition showed nearly

perfect performance (2.00 trials), requiring an average of only 2.20 trials to reach criterion. Reversal performance (the ability of the subject to give the stimulus item when shown the response item) was also evaluated after acquisition of the pairs under the various conditions. Turnure and Walsh found that the children required to label pictures made significantly more errors than those required to repeat either sentences or paragraphs. The latter two did not differ significantly from each other. Again, however, both were performing nearly perfectly (.30 and .10 errors), and differences between the two may thus be obscurred by a ceiling effect. Although the extension of a verbal context in which pairs are presented beyond that of a single sentence does not appear to increase the level of reversal performance following acquisition, the results of Turnure and Walsh do suggest that the extension of the verbal context to a paragraph does have significant facilitation effects in the acquisition of paired-associates.

In a subsequent study, Turnure (1971) investigated the effects of four types of verbal elaboration (labeling, sentences, and two types of paragraphs) on the learning and reversal of paired-associates by educable mentally retarded children. It was hoped that by increasing the number of pairs to be learned to eight, the ceiling effect (the nearly perfect performance of subjects in the paragraph condition) present in the Turnure and Walsh study would be eliminated and possible differences

between the two paragraph types would be discovered. The Turnure and Walsh study had included two types of paragraphs within their paragraph condition and did not attempt to evaluate their effects separately. In the first type, referred to by Turnure as the Semantic Paragraph condition, the two items to be associated were placed within the same sentence and a second sentence was used to further elaborate the association (e.g., "The cat is looking at the broom. He wants to play with it."). In the second type, called the Syntactic Paragraph, the two items to be associated were related in separate sentences (e.g., "He is pulling the wagon. It is full of scissors."). Turnure (1971) again found that verbal elaboration (sentences and paragraphs) significantly facilitated the acquisition of the word pairs over that of labeling, and that either type of paragraph elaboration produced statistically significant increments beyond the effects of simple sentences. No differences, however, were found between the two paragraph types. Once again, subjects in the paragraph conditions performed nearly perfectly, requiring only 3.13 and 3.38 trials for the semantic and syntactic paragraphs, respectively, to reach a criterion of two successive errorless trials. Also, no differences were found in the reversal performance of the three elaboration groups (all groups averaged less than one error in reversal).

The failure to find differences in acquisition per-

formance in the two paragraph conditions, both of which led to performance significantly superior to that of the sentence condition, led Turnure to hypothesize that it is the mere extension of the verbal context in which the items are presented which enhances the subject's comprehension of the relations between the items and thus facilitates his acquisition of the pairs.

A number of factors which existed in the Turnure studies, however, appear to be confounded. The procedures used in both the Turnure and Walsh (1971) and Turnure (1971) studies called for an initial presentation interval of seven seconds, during which the experimenter showed pictures of the stimulus and response items to the subject. Immediately upon presentation of the pictures, the experimenter uttered either labels for the pictures, a sentence, or a paragraph, and the subject was required to repeat the utterance. Although the pictures were removed from the subject's view after seven seconds, it is possible that subjects given the longer utterances were not able to listen to and repeat them within a seven second period. No evaluation of this timing procedure was available in either of the studies. In a recent pilot study with nursery school children (mean CA=51.4 months), however, it was noted that even though experimental procedures called for a training interval of seven seconds for each pair, actual training times differed with the condition. The mean training time

across the pairs in each of the conditions was as follows in the pilot study: Labeling -- 8.14 sec.; Sentence -- 11.18 sec.; Semantic Paragraph -- 18.35 sec.; Syntactic Paragraph -- 16.44 sec. An analysis of variance showed that these training times were significantly different ($F=10.7$; $df=3, 41$; $p<.01$). Further analysis using a Newman-Keuls test for differences among the means revealed that the sentence condition training trail was significantly longer than that of the labeling condition ($p<.05$), and the paragraph conditions had training trials longer than both the sentence and labeling condtions ($p<.01$); the two paragraph conditions did not differ in training trial times.

Generally, it seemed that the timing differences found in the pilot study were due to the inability of the subject to listen to the longer utterances and repeat them within a seven second interval. It may be that the timing differences found with nursery school children exaggerate any timing differences that may have existed in the Turnure studies since young children seem to be slower in repeating an utterance than older retarded children. Furthermore, it is possible that there were experimenter differences in the time taken to verbalize the elaborators in the two studies. It is possible that the experimenter in the pilot study took a longer period of time to initially present each elaborator, thus making it impossible for the subject to be able to listen to and repeat the utterance

within a seven second interval. Although it cannot be determined whether the timing differences found in the pilot study actually existed in the Turnure (1971) study, the fact that the differences in the length of training trials directly corresponds to the differences found by Turnure among the four conditions, makes it possible that the differences in learning were due to differences in training times rather than to the conditions themselves. Further investigation, in which the training trial time is strictly controlled across the conditions, is obviously needed.

A second source of possible confounding arises from the sentence-form of the elaborators used in the various elaboration conditions. All elaborators in Turnure's sentence condition were simple declaratives. Both of his paragraph conditions, however, included some paragraphs which contained at least one imperative sentence-form (e.g., "Wash the cup with soap. It is very dirty.") and others which contained at least one interrogative sentence-form (e.g., "Where is the gray hat? It is on the lamp."). One might hypothesize that the difference Turnure found between the effects of the sentences and paragraphs in facilitating paired-associate performance was in fact a difference between the effects of declarative sentence-forms and those of imperative and interrogative sentence-forms. This hypothesis would assume that imperatives and interrogatives somehow are more effective as elaborators than

are simple declaratives. Since the relative effects of the various sentence-forms is not known, a study of the extended elaboration conditions is needed in which the form of the elaborators is controlled across all elaboration conditions, either by using only one type within all conditions, or by balancing the types in each of the conditions.

A third factor, the number of pairs used by Turnure to investigate the differences in effectiveness of the various elaboration conditions, also limits the conclusions which can be drawn from his results. As Runquist (1966, p.504) notes, when determining the number of pairs to be used in a verbal learning task, "care must be taken not to make lists too short, or learning time will be so rapid that the effects of many variables will not be measurable." Although Turnure (1971) had increased the list length to eight pairs after noting the ceiling effects in the paragraph conditions when four pairs were used (Turnure & Walsh, 1971), a ceiling effect still may have been operative. Many subjects in both of the paragraph conditions performed at a nearly perfect level, and any differences that may exist between the two paragraph types were not evident. Further investigation of the effects of the various elaboration conditions would thus seem to be a fruitful line of research, both to determine if increased task difficulty will limit the effectiveness of the elaborators in paired-associate learning, and to determine whether differences between

the paragraph elaborators can be found when a more difficult task is employed.

Research Design

The present study was designed primarily to extend the mediational research of Turnure and his associates by investigating the effects of list length on verbal elaboration phenomena. In attempting such a replication and extension of the previous work, a number of objectives were kept in mind.

First, it was decided that strict timing procedures would be used throughout the study. Because the pilot study revealed that nursery school children required an average of 18.35 seconds in the condition where they took the most time to listen to and repeat the given utterance (the Semantic Paragraph condition), it was determined that the training time for each pair in all conditions would be somewhere around this maximum time. Also, since it was felt that the younger nursery school children had somewhat more difficulty repeating the utterances than would the retarded children to be included in the study, the training time for each pair was set at 15 seconds. In addition, it was decided that the time allowed for the subject to give a response during acquisition (3 seconds in the Turnure studies) would be increased to 20 seconds so that the retarded subjects would be given enough time to mediate (if, as Penney et al. suggest, the retarded subject does have slower mediational processes) and to measure

any differences in response latencies for correct and incorrect responses in the various treatment groups.

Secondly, the present study was designed so that the three sentence-forms included in the Turnure study (simple declaratives, imperatives, and interrogatives) would be balanced across the three conditions. In the paragraph conditions, where two simple sentences were used, the paragraph type was classified as other than a declarative if one of the two sentences was other than a simple declarative. In this way it was hoped that not only the effects of the different types of sentences would be balanced across the conditions (so that condition differences could be measured without confounding by the sentence-form), but also any differential effects which might exist between the effectiveness of the sentence-forms could be measured and analyzed.

Another objective of the present investigation was to test the hypothesis proposed by Sachs (1967) that the original form of an elaborator (sentence) given to the subject is stored only for a short time necessary for comprehension. After that, it is the meaning of the elaborator which is stored. In order to investigate this hypothesis, subjects were asked to recall as accurately as they could the elaborators which had been given to them during training.

The major purpose of the present study was to measure the relative effectiveness of the three elaboration conditions used by Turnure (Sentences, Semantic Paragraphs, and Syntactic

Paragraphs) under conditions of increased task difficulty. This was to be accomplished by increasing the list length from 8 to 12 and finally, to 16 pairs. It was felt that the inclusion of the control (Labeling) group was unnecessary since its poor performance relative to groups receiving elaborators is well documented. As Davidson and Dollinger (1969, p.9) state, "future experiments that aim at assessing the effects of various kinds of syntactic mediation might deem it unnecessary, except in special cases, to include a traditional PA control. Such a group seems to add little to the assessment of syntactic mediators." By thus increasing the number of pairs the subject was to learn, it was felt that the ceiling effect present in the paragraph conditions of the Turnure study could be eliminated and that the relative effectiveness of the elaboration conditions on both acquisition and reversal performance could be measured under various levels of task difficulty.

It was originally felt that an exact replication of Turnure's procedures could be used across all list lengths in the present study. Following a training trial with all pairs, Turnure required his subjects to learn the pairs to a criterion of two successive errorless trials, and then to respond in a reversal task for two trials. Subjects had to respond to all eight pairs during each trial. The number of trials to reach criterion in acquisition was taken as the

measure of performance under each of the elaboration conditions. A pilot study to test these procedures, however, revealed that a modification of the Turnure procedures would be necessary to look at the effects of elaboration under conditions of increased task difficulty. When older nursery school children were used as subjects (these children had previously been found to perform comparable on a 4-pair list under elaboration conditions to educable retarded children; Turnure, Thurlow, & Larsen, 1971) it was noted that they became bored, frustrated, and even angry when they were required to learn 12- or 16-pair lists in the traditional manner used by Turnure. Even when acquisition was rapid (13 of 16 pairs correct on the first trial; 4 trials to criterion), the requirement that all pairs be responded to correctly twice in a row resulted in a very time consuming task (30 minutes). This finding, plus the possibility that some of the retarded subjects might have more difficulty with the task (and thus might be required to spend more than an hour in the experimental situation) made the need for a modification of the traditional paired-associate learning-to-criterion task imperative.

For these reasons, it was decided that a method of adjusted learning would be employed in the present investigation in order to reduce the excessive time requirements imposed on the subject by the traditional anticipation-to-criterion method in the 12- and 16-pair lists. In the adjusted

learning method, only those pairs missed during a given trial are repeated in the following trial; those pairs correctly responded to are dropped out. Although this method was first proposed as a means of equating original learning across fast and slow learners in retention studies (Gillette, 1936; cf. Belmont, 1966; Keppel, 1968), it seemed to be a desirable method here for somewhat reducing fatigue and increasing motivation in subjects required to learn lists of extended length.

Because of the modification in learning procedures, it was decided that acquisition performance would be measured both in terms of the number of errors made on the first acquisition trial, and in terms of a modified trials to criterion measure (the number of trials required for the subject to correctly respond to all word pairs on a final full trial after all pairs had been dropped out). It should be noted that this measure of trials to criterion will not be comparable to that obtained by Turnure (1971), where a traditional learning procedure was used (cf. Stinnett & Prehm, 1970). The measure of the number of errors made on the first acquisition trial should, however, provide an adequate means for a comparison of the results of the present study with those obtained by Turnure, and, following the procedures of Turnure, it was decided that *t* tests would be used to compare the three elaboration conditions within each list length. Furthermore, with the use of proportions, it will be

possible to compare performance under the various elaboration conditions, across the different list lengths.

The second measure, the number of errors made on the first acquisition trial, was considered to be possibly a more important measure of the effects of elaboration. Davidson and Dollinger (1969) have suggested that syntactic facilitation seems to leave its greatest effect on the initial trial, and Rohwer (1966) has noted that trials to criterion is perhaps a less sensitive measure of the effects of elaboration training than performance on the first trial. It was thus felt that the number of errors on the first acquisition trial would give a measure of facilitation without involving a measure of the learning ability of the subject. In order to insure that performance obtained in the present study could be compared with that obtained by Turnure (1971), his original data were re-analyzed in terms of the number of errors made on the first acquisition trial. Following the procedure he used to analyze his original trials to criterion data, a t test for differences among several means was carried out on the error scores. It revealed that performance under each of the paragraph conditions was superior to that under the sentence condition (both p's $< .05$), and that there were no significant differences between the two paragraph conditions. These results directly parallel those obtained by Turnure when acquisition performance was analyzed in terms of trials to criterion. This finding suggests

that a replication which uses the number of errors made on the first trial as the performance measure should produce results comparable to those of Turnure's investigations. Furthermore, data from the 12- and 16-pair lists should directly extend Turnure's findings even though the learning method and performance measure being used here are different.

The study reported here was thus undertaken to clarify and extend the investigation of verbal elaboration phenomena by investigating the effects of increased task difficulty. Specifically, it was an attempt to investigate the relationships between three forms of elaborators -- Sentences, Semantic Paragraphs, and Syntactic Paragraphs -- under list lengths of 8, 12, and 16 pairs. Although the investigation was initiated as a replication and extension of Turnure's work, several characteristics of his investigation were changed in order to provide more control so that the effects of a number of factors would not be confounded. Strict timing procedures were employed and the form of the elaborators used were balanced across conditions. In addition, the learning method was changed from a traditional anticipation-to-criterion procedure to one of adjusted learning, and performance measures were modified accordingly. It was hypothesized that as list length was increased and ceiling effects disappeared, the differences between the effects of the various elaboration conditions on acquisition and reversal performance would become evident.

Method

Subjects. In selecting subjects to be included in the present study, there was an attempt to replicate the selection procedures employed in the Turnure (1971) study. Subjects were thus selected on the basis of IQ and chronological age (CA), with the restriction that no subject showed any gross sensory, motor, or speech defects. Seventy-five educable mentally retarded children from special classes in five St. Paul, Minnesota public schools were employed. These children were roughly equated for IQ, CA, and then mental age (MA), and randomly assigned to nine treatment groups. Five subjects (3 males, 2 females) were assigned to each elaboration condition in the replication of Turnure's 8-pair list, and ten subjects (7 males, 3 females) were included in each of the elaboration conditions in the 12- and 16-pair lists. The mean IQ's, CA's, and MA's of the nine experimental groups in this 3 (elaboration condition) x 3 (list length) design are presented in Table 1. It should be noted that the children used in this study had slightly higher IQ's, CA's, and MA's than the children in Turnure's study, where the approximate means were 68.7, 115.7, and 80.0, respectively. Although it was intended that these population characteristics would be replicated, it was impossible due to the higher IQ's and CA's of the available subjects.

Materials. Stimulus materials employed in the present

Table 1

Means and Standard Deviations of Intelligence Quotients, Chronological Ages, and Mental Ages for each Treatment Group

Treatment Group	IQ	CA (in months)	MA (in months)
8 Pairs (n=15)			
Sentence			
$\bar{X}$	74.2	123.6	92.4
SD	4.8	14.3	10.4
Semantic Paragraph			
$\bar{X}$	74.0	125.4	93.0
SD	5.7	12.8	8.5
Syntactic Paragraph			
$\bar{X}$	73.8	122.8	91.4
SD	5.4	14.8	12.1
12 Pairs (n=30)			
Sentence			
$\bar{X}$	74.2	125.6	93.6
SD	5.0	13.3	11.5
Semantic Paragraph			
$\bar{X}$	73.9	123.9	92.0
SD	4.9	17.2	14.4
Syntactic Paragraph			
$\bar{X}$	74.1	126.4	93.9
SD	4.6	15.2	12.4
16 Pairs (n=30)			
Sentence			
$\bar{X}$	73.9	121.5	90.4
SD	4.7	14.1	10.3
Semantic Paragraph			
$\bar{X}$	73.6	124.8	91.3
SD	5.2	17.6	9.1
Syntactic Paragraph			
$\bar{X}$	73.8	122.2	90.8
SD	4.6	11.2	7.4

study consisted of 32 colored pictures of common objects. The pictures were taken from a preprimer workbook and individually mounted on white cardboard (8.9 x 6.4 cm.). Sixteen stimulus-response pairs were formed such that no obvious or common relations of sound or meaning existed between the members of a pair. The 8-pair list was constructed of pairs which corresponded to those used by Turnure (1971). The 12-pair list consisted of these 8 pairs plus 4 additional pairs selected randomly from the remaining eight pairs. For each pair, a sentence, a semantic paragraph, and a syntactic paragraph elaborator was constructed with the intention of keeping the meaning of each of the elaborators for a given pair as comparable as possible. In addition, the number of declaratives, imperatives, and interrogatives in each of the elaboration conditions was held constant across conditions within each list length. A list of all pairs and their various elaborators is included in Appendix 1.

Procedure. Subjects were required to learn either 8, 12, or 16 word pairs in the present experiment so that the effects of list length on learning under various elaboration conditions could be evaluated. An initial training trial in which the pairs were elaborated within either sentences, semantic paragraphs, or syntactic paragraphs, was given to all subjects. In the Sentence condition, subjects repeated short sentences relating the stimulus and response items

(e.g., "The carrots are growing by the gate."). In the Semantic Paragraph condition, two-sentence paragraphs in which both stimulus and response items were contained in the first sentence (e.g., "The carrots are growing by the gate. Did you pick one?") were repeated by the subjects. In the Syntactic Paragraph condition, subjects were required to repeat two-sentence paragraphs in which the stimulus and response items occurred in separate sentences (e.g., "Here are some carrots. They are growing by the gate."). During the training trial, each stimulus-response pair was presented to the subject for 15 seconds while the experimenter uttered the appropriate elaborator and the subject repeated it. After all pairs in the list were presented in this manner, acquisition trials began.

A method of adjusted learning was employed in the present experiment because of the excessive time requirements imposed on the subject in the 12- and 16-pair lists by the traditional anticipation-to-criterion method. In the first acquisition trial, each of the stimulus pictures was presented to the subject one at a time, and he was required to give the name of the corresponding response picture. These were presented in an order different from that used in the training trial so that possible serial learning effects would be eliminated. If an incorrect response was given or if the subject had not responded within 20 seconds, an incorrect response was scored.

After a response was made or 20 seconds had passed, the stimulus and response pictures were presented together for 5 seconds. Following this first trial, only those stimulus-response pairs which were missed on the preceding trial were presented to the subject. When all pairs had been dropped out in this manner, an additional trial in which all pairs were presented was used in order to be sure that the subject had learned all pairs, and to equate the recency of each pair. If additional pairs were missed during this trial, the dropping out of pairs and the final full trial were repeated. Acquisition performance was measured both in terms of the number of errors made on the first trial and in terms of a modified trials to criterion measure (the number of trials required for the subject to correctly repsond to all word pairs on the final full trial).

A single reversal trial was given following acquisition of the stimulus-repsonse pairs. During this trial, the picture which was formerly the response item was shown to the subject and he was required to name the corresponding stimulus item. The subject was not informed of the change, and the task continued following acquisition as if no change had occurred. Reversal performance was measured in terms of the number of incorrect responses made.

Throughout these three stages of testing (training, acquisition, and reversal), timing measures were recorded by use of a Rustrak event recorder. Training trial times for

each pair were recorded from the point of initial presentation of the pair to the point at which it was removed from the subject's view. Although experimental procedures called for a constant training time of 15 seconds for each pair, it was expected that there would be some variability due to experimenter error and the inability of some subjects to repeat the elaborators within the 15 second period. The use of the Rustrak recorder thus allowed for accurate measurements of actual training times in each condition. Following training, response latencies were measured during acquisition and reversal. The latency of a response was taken to be the time between the presentation of the stimulus item and the first complete response given by the subject, whether it was correct or not.

After the reversal trial was completed, a number of subjects were asked to recall the elaborators that they had repeated during the training trial. Due to time limitations, only 5 subjects, selected randomly from each treatment group, were asked to recall the elaborators. This included all subjects given the 8-pair list and half the subjects given the 12- and 16-pair lists. Responses were scored as to whether or not they conformed to the form of the elaborator (declarative, imperative, or interrogative) and the structure of the elaborator (sentence, semantic paragraph, or syntactic paragraph) which had originally been given.

Results

The mean training trial time for each pair in the nine treatment groups was quite constant in the present experiment. Means ranged from 14.7 seconds in the 12-pair, Syntactic Paragraph condition to 15.3 seconds in the 16-pair, Semantic Paragraph condition. A two-way analysis of variance revealed no significant effects (all F's < 1). It thus seems that training time differences, which may have been present in the Turnure studies, are definitely eliminated here, and that any differences found between the elaboration conditions will not be confounded with the effect of training times.

The mean number of first trial errors and the mean number of trials to criterion for each of the treatment groups are presented in Table 2. The proportion of first trial errors to the number of pairs in the list, shown in the second column, allows for the comparison of acquisition performance across the various list lengths. The results are presented graphically in Figure 1, where the proportions have been converted to percentages.

One of the most interesting features of these results is the outstanding performance of the retarded subjects at increased levels of task difficulty. Even when required to learn 12 or 16 word pairs, subjects were able to respond correctly to 60% of the pairs on the first trial. The facilitative effect of providing the subject with verbal elaborators is obvious

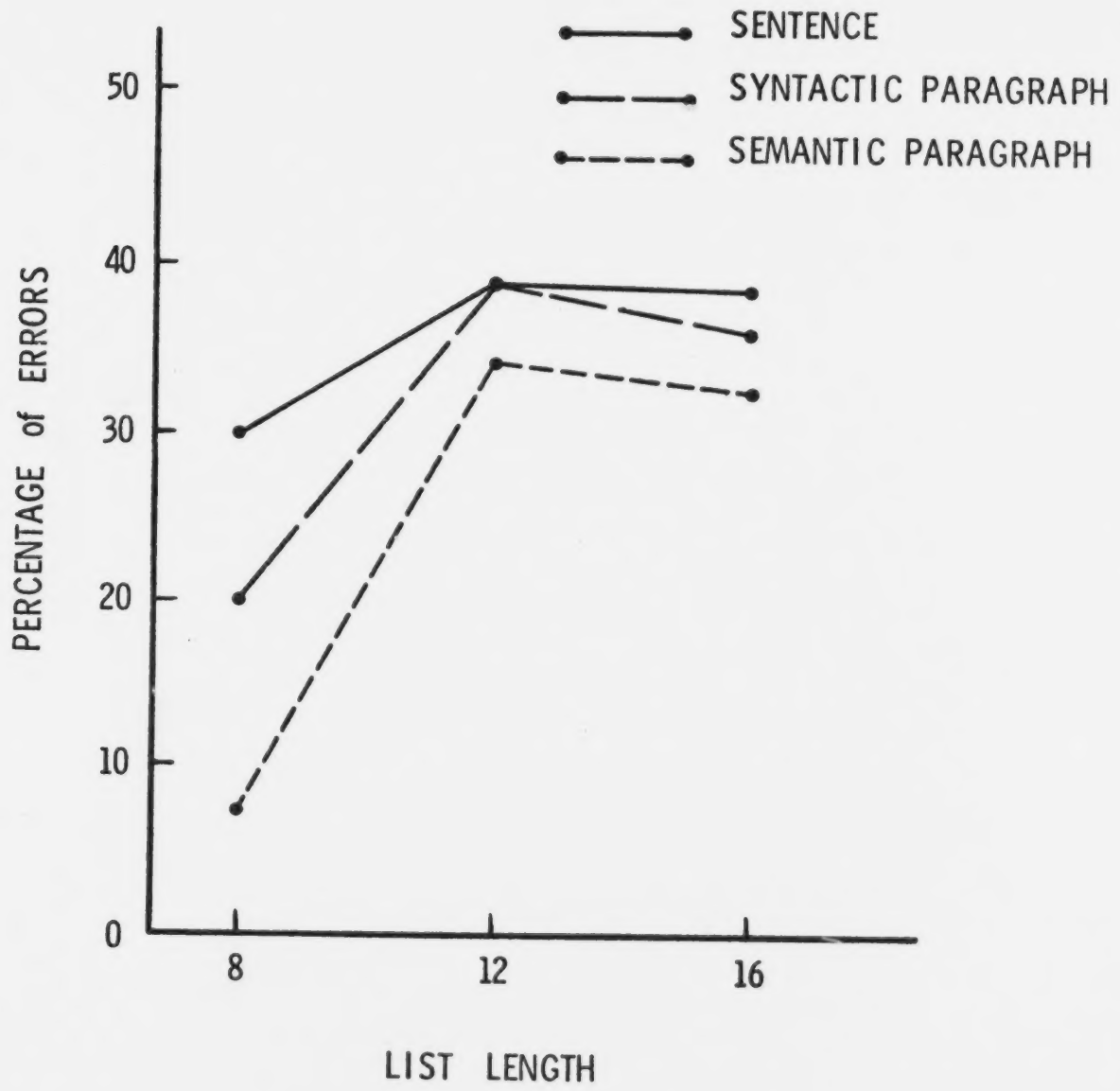
Table 2

Means and Standard Deviations of First Trial Errors and Trials to Criterion for each Treatment Group

Treatment Group	First Trial Errors	Proportion of First Trial Errors	Trials to Criterion
8 Pairs (n=15)			
Sentence			
$\bar{X}$	2.40	.300	3.80
SD	.89	.111	1.79
Semantic Paragraph			
$\bar{X}$	.60	.075	2.60
SD	.55	.068	.55
Syntactic Paragraph			
$\bar{X}$	1.60	.200	3.20
SD	1.14	.142	1.10
12 Pairs (n=30)			
Sentence			
$\bar{X}$	4.70	.392	5.10
SD	2.21	.184	2.13
Semantic Paragraph			
$\bar{X}$	4.10	.342	5.20
SD	1.73	.144	1.69
Syntactic Paragraph			
$\bar{X}$	4.70	.392	5.30
SD	2.45	.204	2.31
16 Pairs (n=30)			
Sentence			
$\bar{X}$	6.20	.388	6.90
SD	2.90	.181	3.48
Semantic Paragraph			
$\bar{X}$	5.20	.325	5.40
SD	3.46	.216	3.06
Syntactic Paragraph			
$\bar{X}$	5.80	.363	5.20
SD	2.62	.163	2.35

Figure 1

Percentage of First Trial Errors



when this is compared with the performance of subjects included in the study by Turrure (1971). When asked to perform on an 8-pair list in a labeling condition, they were able to respond correctly to only 12.5% of the pairs on the first acquisition trial.

A 3 (elaboration condition) x 3 (list length) factorial analysis of variance was carried out on the proportion of error scores. The main effect of list length was the only factor found to be significant ($F=6.22$; $df=2,66$; $p<.01$). To test the differences between all possible pairs of means within the logical groupings of elaboration condition, a Newman-Keuls procedure was adapted for use (Winer, 1962, p. 238). Because of the differences in variances within each condition, only those cells from which the means were obtained were used in estimating the standard error of the mean. This procedure revealed a significant difference only within the Semantic Paragraph condition, where a significantly smaller proportion of errors was made on the 8-pair list than on the 12- or 16-pair lists ($p<.05$).

Since pre-experimental plans were to compare the effects of the three elaboration conditions within each list length, t tests to compare the error means were performed even though the main effect of elaboration condition was not significant in the two-way analysis ($p<.20$). Comparison of the three elaboration conditions within each list length revealed a

significant effect only in the 8-pair list, where the Semantic Paragraph mean was significantly smaller than the Sentence mean (t=3.84; df=8; p<.01 ; two-tailed test). The Syntactic Paragraph mean did not differ from either the Semantic Paragraph mean or the Sentence mean in the 8-pair list. No significant differences were found between the elaboration within either the 12- or 16-pair lists. Similar analyses using trials to criterion as the performance measure did not reveal any significant differences.

Performance on the reversal task was extremely good regardless of which elaboration condition the subject was in, or of the number of pairs he had been required to learn. Because no subject made more than two errors on the reversal task, the mean number of errors made in each treatment group was extremely small (all means <.90). An analysis of the mean number of errors for each elaboration condition within each list length revealed no significant effects (smallest probability level; .05 <p<.10). Observation of the precentages of subjects performing errorlessly in each of the treatment groups, shown in Table 3, reveals the high level of performance of all subjects in the reversal task.

The investigation of differences in performance with regard to the three sentence-forms of the elaborators (declaratives, imperatives, and interrogatives) was restricted to the 8 pairs to which all 75 subjects were exposed. The percentages

Table 3

Percentages of Subjects Performing Errorlessly

on Reversal in Nine Treatment Groups

Elaboration Condition	List Length		
	8 Pairs	12 Pairs	16 Pairs
Sentence	60% (3/5)	100% (10/10)	50% (5/10)
Semantic Paragraph	100% (5/5)	80% (8/10)	80% (8/10)
Syntactic Paragraph	60% (3/5)	60% (6/10)	80% (8/10)

of incorrect responses within the three types of elaborators across all treatment groups were 27.4, 29.5, and 44.1, respectively. Analyses using t tests for related means revealed that the mean percentage of errors made for the interrogative pairs was significantly greater than for the imperatives (t=2.85; df=74; p<.01) and also than for the declaratives (t=5.06; df=74; p<.001). The means for the declaratives and imperatives did not differ. These results must be viewed tentatively, however, since the experimental design did not control the form of the elaborator across all word pairs. The various sentence-forms were not balanced within any one word pair, so that differences which seem to be attributable to the form of the elaborator might as well be due to the ease of associating a particular pair of words. To remove this confounding, each word pair would have to be presented in each of the three sentence-forms. This was not done in the present experiment.

Response latencies for correct responses and overt incorrect responses are shown in Table 4. Although these overall latencies were quite constant across subjects, the variances within subjects were large. Most notably, there was a definite decrease in the time taken to respond across trials. Furthermore, inspection of the latencies for correct responses reveals that all means were below 3.6 seconds. In fact, scoring of the original response latency data showed that 90% of all correct responses were given in less than 6.0

Table 4

Mean Response Latencies (in seconds) for Correct and Incorrect Responses for Nine Treatment Groups

Elaboration Condition	List Length: 8 Pairs	12 Pairs	16 Pairs
Sentence			
Correct	2.7	3.1	2.8
Incorrect	8.6	8.7	8.0
Semantic Paragraph			
Correct	2.2	3.6	2.8
Incorrect	11.1	11.2	8.8
Syntactic Paragraph			
Correct	3.2	2.2	3.0
Incorrect	5.8	7.7	7.7

seconds. In comparing the latencies for correct and incorrect responses, the most consistent finding was that the latencies for incorrect responses were longer than those for correct responses; *t* tests of these differences for each of the conditions in the 12- and 16-pair lists revealed that all were significant (all *p*'s<.01). Tests for differences were not carried out in the 8-pair list due to the small number of subjects making any incorrect responses in this condition. Two-way analyses of variance (elaboration condition x list length) were carried out on the response latencies for both correct and incorrect responses. Neither analysis showed any of the effects nor their interaction to be significant.

Scoring of the recall responses revealed that all subjects were able to recall at least the meaning of most of the elaborators which had been given during training. The form (declarative, imperative, or interrogative) and the structure (sentence, semantic paragraph, or syntactic paragraph) of the elaborator were not uniformly recalled, however. Although subjects were able to recall approximately 50% of the elaborators in the same form as they had been given, most of those correctly recalled were of the declarative type. Furthermore, for those elaborators in which the form was incorrectly recalled, subjects almost uniformly transformed them to a declarative form. With regard to the structure of the elaborators, scoring of the recall responses showed that while subjects in the

sentence conditions did recall the elaborators in the form of a sentence, those in the paragraph conditions recalled the elaborators in the form of a paragraph only 22 to 46 percent of the time. When elaborators were not recalled as paragraphs, they were transformed to either simple or compound sentences which generally retained the meaning of the original paragraph.

Discussion

The present study investigated the effects of list length on verbal elaboration phenomena in order to extend the mediational research of Turnure and his associates (Turnure, 1971; Turnure and Walsh, 1971; Turnure, Larsen & Thurlow 1971; Turnure, Thurlow & Larsen, 1971). The data, however, are relevant both to the research of Turnure and to a number of hypotheses related to the processes and stimuli involved in verbal elaboration studies. Furthermore, the results of the investigation provide pertinent information on the effects of verbal elaboration in educable mentally retarded children.

In the present study, the response interval was set at 20 seconds so that little restriction would be placed on the time required for mediational processes to occur in the retarded subjects. This was done, in part, as a result of the findings of a study by Penney et al. (1968). Using a six second response interval, they had found the performance of retarded subjects to be below that of normal subjects in a traditional three-stage mediational paradigm. It was suggested that this occurred

because the six second interval blocked the run-off of the A-B-C chain in retarded children. As a result of these findings, Penney et al. hypothesized that mediational processes are slower in the retarded child than in the normal child (cf. Penney, Peters, & Willows, 1968). The response latency data from the present study, however, revealed that 90% of all correct responses made by the retarded subjects were given in less than 6.0 seconds. It appears, then, that verbal elaboration contexts such as those used in the present study (sentences and paragraphs) facilitate mediational processes in retarded children in such a way as to reduce the time needed for the processes to occur. The applicability of the hypothesis proposed by Penney et al. to all types of mediational tasks would have to be questioned in light of the results of the present study. Research comparing the response latencies of normal and retarded children in a paired-associate task where the items are related within verbal contexts would seem to be a promising line for further research in testing the hypothesis that mediational processes in the retarded child are actually slower than in the normal child.

The response latency data also revealed that there were statistically significant differences between the times taken to give an incorrect response and a correct one. In all treatment groups, longer times were taken for an incorrect response to be made. These data suggest that the use of verbal

adequately described when viewed solely as the segmentation and classification of words into categories (noun, verb phrase, etc.). Rather it is the nature of the relations among items and phrases that distinguish sentences from word lists." It seems, then, that the large percentage of pairs correctly recalled during the first acquisition trial was related to the ability of the subject to store the meaning of the elaborators given during training. A more direct test of this would be to test for retention of the elaborators immediately following a test for the recall of each pair. The findings of the present study, however, appear to support Sachs' hypothesis. It seems to be the meaning of the elaborator, or the relationships it suggests between the paired items, which is stored by the subject and which facilitates his performance on the task.

The suggestion that the meaning or relationships formed between two items is the important variable in the facilitation of paired-associate performance has recently received considerable attention (Anderson 1970; Asch, 1969; Bobrow & Bower, 1969; Turnure, 1971). Kohler (1929, p. 290) originally referred to the importance of some form of organization in associating items when he stated, "Where organization is naturally strong,we have spontaneous association; where there is practically no organization association does not occur until some organization is created intentionally." From this,

Epstein, Rock, and Zuckerman (1960, p. 15) suggest that "material learned under conditions which encourage the formation of a unit should fare better than material presented under conditions which do not in any special way facilitate the occurrence of unit formation." Verbal elaborators which provide unit formation or meaningful relations between two items to be paired should thus facilitate paired-associate performance while elaborators which do not form such units or relations should not. Numerous research endeavors have documented the facilitation resulting from sentences which relate paired items, but there have been relatively few attempts to demonstrate that sentences which do not meaningfully relate the items do not facilitate learning. Relevant to this latter hypothesis is a study cited by Bower (1970). It was found that when subjects were instructed to elaborate only the stimulus item of a pair, rather than a relationship between the stimulus and response items, their recall was no better than that of subjects instructed to repeat the two items (mean percentage of recall: Elaboration - 50%; Repetition - 53%). A similar finding was obtained by Rohwer (1966). He found that meaningful English sentences facilitated paired-associate performance relative to a control group, whereas nonsense sentences did not. It appears that stronger associations between items arise when the verbal elaborator is constructed in such a way as to form a strong relational organization between the two items. Future investigators

attempting to facilitate learning processes in retarded individuals would benefit, it would seem, by developing instructional or training methods for increasing the formation of meaningful relations between items to be associated.

The major purpose of the present study was to measure the relative effectiveness of the three elaboration conditions used by Turnure (Sentence, Semantic Paragraph, and Syntactic Paragraph) in lists of three lengths (8, 12, and 16 pairs). In order to increase the validity of the present results, a number of controls were added to the materials and procedures used by Turnure (1971) so that possible confounding could be eliminated. First, strict timing procedures were used during the training trial. Analysis of the actual training times for each pair did not reveal any differences in the times for the various conditions. Thus, the possible confounding from differential training times, which may have existed in previous studies, has been eliminated here, and cannot be used to account for any differences which exist between the experimental conditions.

A second possible source of confounding was controlled by balancing three types of elaborators (declaratives, imperatives, and interrogatives) within all conditions. This had not been done in the Turnure study, where only declarative elaborators were included in the Sentence condition while both paragraph conditions were made up of imperatives and

interrogatives as well. In analyzing the present data to see if differential effects might exist between these various sentence-forms, it was found that for eight pairs similar to those used by Turnure, significantly fewer errors were made for pairs which had been related in declarative or imperative elaborators. If this finding is accurate and the effects found by Turnure were in fact due to the sentence-form rather than the elaboration condition, one would predict that fewer errors would be made in the Sentence condition than in the paragraph conditions. This is exactly the opposite of what Turnure found, however. It appears, then, that the differences he found cannot be traced to the differential sentence-forms included in his elaboration conditions.

Although it is possible that the meaning of the interrogative syntactic construction was more difficult to comprehend and retain (no literature could be located which related to this hypothesis with retarded children), the differences found between the three sentence types in the present study must not be accepted without caution since the sentence-forms were balanced within the conditions but not within the word pairs. The fact that the word pairs elaborated within interrogative sentence-forms were harder might have been due to the fact that these particular pairs were inherently more difficult to associate. This seems unlikely, however, since the pairs were randomly assigned to the sentence-form conditions. A

second possible explanation for their difficulty might be that it was an artifact of the construction of the elaborators. Interrogative elaborators characterized by sufficient meaning or the formation of a "conceptual unit" between the paired items may have been more difficult to construct than declarative and imperative elaborators with such characteristics. The need for caution in interpreting the differences found between the various sentence-forms is further supported by a recent study by Bobrow and Bower (1969). With the sentence types balanced within the word pairs, they found no differences in the effects of sentence-forms similar to those used here.

The effects of training time and sentence-form were thus controlled across the various elaboration conditions in the present study. With these possible confounding effects eliminated, the effects of the three elaboration conditions were investigated in three list lengths. Turnure (1971), using an 8-pair list, had found that performance in the two paragraph conditions was significantly better than in a Sentence condition. The effects of the two types of paragraphs did not differ. In the present study, it was hypothesized that Turnure's failure to find differences between the semantic and syntactic paragraphs might have been due to a ceiling effect which seemed to be present. With respect to this hypothesis, the list length was increased from 8 to 12 and 16 pairs, with the hope that possible differential effects of the two paragraph conditions might emerge. Quite the

opposite was found. It was only in the 8-pair list that the three elaboration conditions were found to have differential effects. It should be noted, however, that the difference found between the Sentence and Semantic Paragraph conditions did not emerge in the two-way analysis of variance, but was found only by means of a *t* test selected in order to replicate Turnure's procedures of analysis.

As in the Turnure study, no differences were found in the performance of subjects in the three elaboration conditions on a reversal task following the acquisition of paired-associates (see also Turnure & Walsh, 1971). At all list lengths, performance was nearly perfect. The present data thus seem to provide further support for Turnure's (1971) suggestion that once meaningfully related items are organized and stored in the memory, they are available for retrieval and use in any sequence. The data presented in Table 5 summarize the results of some of the available studies on backward associations in normal and retarded children. The findings of these studies appear to support Turnure and Walsh's (1971) original observation that the acquisition of associations under conditions of extended verbal mediation significantly enhances the availability of backward associations as compared to conditions in which associations are rotely acquired.

Perhaps the most unexpected result of the present study was the failure to find larger differences between the elaboration conditions at longer list lengths. In fact, with increasing

Table 5
Summary of Studies Investigating Backward Associations in Children

Study	Subjects	Percentage of R-S Recall: Traditional P-A Task	Percentage of R-S Recall: Elaboration Task
2 Pairs			
Palermo (1961) Mixed list List criterion-1 errorless trial	Normals CA = 9-12 years	38.5%	--
Baumeister, Kellas & Gordon (1970) Study II Mixed list List criterion-1 errorless trial	Normals CA = 9.2 years	75.0%	--
	Retardates CA = 20.8, MA = 9.2	50.0%	--
4 Pairs			
Turnure, Thurlow & Larsen (1971) Study III List criterion-2 errorless trials	Normals CA = 4.4 years	54.7%	87.5% (Sem. P.) 93.8% (Syn. P.)
Study I List criterion-2 errorless trials	Normals CA = 6.0 years	80.0%	97.5% (Sem. P.) 97.5% (Syn. P.)
Turnure & Walsh (1971) Day I List criterion-2 errorless trials	EMR CA = 9.7, MA = 6.5	50.0%	97.5% (Sentence) 97.5% (Paragraph)
6 Pairs			
Kausler & Gotway (1969) List criterion-1 errorless trial	Normals -- Grade K 2 4 6	84.3% 79.2% 87.5% 80.2%	--
Baumeister, Kellas & Gordon (1970) Study I List criterion-1 errorless trial	Normals CA = 9.1 years	71.1%	--
	Retardates CA = 15.8, MA = 9.0	66.0%	
Turnure, Larsen & Thurlow (1971) Study I List criterion-2 errorless trials	EMR CA = 8.7 - 3.1 MA = 4.1 - 10.1	---	93.3% (Paragraph)

8 Pairs

Baumeister & Campbell (1970) List criterion-2 errorless trials	Normals CA = 9.9 years	77.5%	---
Turnure (1971) List criterion-2 errorless trials	EMR CA = 9.6, MA = 6.7	68.8%	95.3% (Sentence) 92.2% (Sem. P.) 90.6% (Syn. P)
Turnure, Thurlow & Larsen (1971) Study II List criterion-2 errorless trials	Normals CA = 7.2 years	---	96.9% (Sentence) 99.0% (Sem. P.) 96.9% (Syn. P.)
Thurlow & Turnure Transfer study (Day 1) List criterion-2 errorless trials	EMR CA = 9.3, MA = 6.9	83.8%	97.5% (Paragraph)
Thurlow - MA thesis List length study Adjusted learning-full trial criterion	EMR CA = 10.3, MA = 7.7		
	# Pairs		
	8	---	95.0% (Sentence) 100.0% (Sem. P.) 95.0% (Syn. P.)
	12	---	100.0% (Sentence) 97.5% (Sem. P.) 95.8% (Syn. P.)
	16	---	95.0% (Sentence) 98.8% (Sem. P.) 98.8% (Syn. P.)

list length, the differences appear to decrease. This trend is further supported by the results of a supplementary study using 24 pairs (see Appendix 2).

One possible explanation of this trend is that with longer list lengths, extended elaborators are no longer effective in differentiating performance. This view would suggest that any additional information provided by the extended elaborators is either not processed or is processed in such a way as to make it ineffective in further facilitating performance beyond that of a sentence. A second interpretation might be that with longer list lengths, the subject benefits from a type of practice effect which wipes out any additional benefits that the paragraphs provide at shorter list lengths. In other words, the practice effects of repeating 12 or 16 elaborators gives the subject a chance to learn to store the pairs as efficiently as possible, and the additional context provided by the paragraph elaborators no longer facilitates performance beyond that of a sentence elaborator. Both of these hypotheses are attempts to explain the finding that there were no statistically significant differences between the effects of sentences and paragraphs at longer list lengths. It should be noted, however, that the relative positions of the paragraphs and sentences were maintained across the three list lengths. In all cases, the mean error performance of subjects in the paragraph conditions was below

that of subjects in the sentence condition.

Clearly, the effectiveness of the elaborators does not decrease at lists of extended length. The percentage of correct responses remains quite constant across all list lengths investigated. Even when required to learn 12 or 16 items (or even 24, see Appendix 2), the educable mentally retarded subjects employed in the present experiment were able to respond correctly to an average of at least 60% of the pairs on the first acquisition trial. The consistency of the mean proportion of correct responses around approximately the 60% mark in the 12- and 16- (and even 24-) pair list lengths merits comment. Given that this mean level of performance of the retarded children studied under conditions of extended list lengths can be said to be "fixed" at a level of 60% correct, the problem remains to account for such consistency. The possibility that the results at the longer list lengths reflect an artifactual "ceiling effect" is precluded by the design of the study, the very intent of which was to eliminate such possible artifacts. Another possibility would be that the 60% correct figure reflects some "psychological ceiling" or inherent capacity limit in the subjects. The individual data, however, do not seem to be amenable to such an interpretation since(1) the absolute performance of groups, and certainly of individuals, at the higher list lengths often exceeds the best possible performance at lower lengths, and(2) signi-

ficant numbers of individual subjects exceed the 60% capacity figure by such a degree as to render it implausible as an upper limit on performance. As may be seen in Figures 2 - 4, the average group performance over list length in any condition masks an extremely wide range of individual performances.

Scrutiny of the individual performance data provides some further information which may help to account for the appearance of the consistent level of performance over such as a broad expanse of task difficulty. In the first place, in the 8-pair list the worst performance noted for any single subject was at the level of 37% errors (the average for all groups given 8 pairs was approximately 13% errors). Clearly, all subjects were performing extremely well at the shortest list length studied. However, when list length was increased to 12 pairs, the observed worst performance leaped to 68% errors for the Sentence and Semantic Paragraph conditions and to 75% errors for the Syntactic Paragraph condition (see Table 6). Although observation of Table 6 suggests an overall escalation of the percentage of errors made by the worst performing subjects with increasing task difficulty, this apparent escalation is not characteristic of the overall group performances. The data of Table 7 clearly show that the percentage of subjects performing

Figure 2

Means, Ranges and Distributions of Error Scores

in Sentence Condition

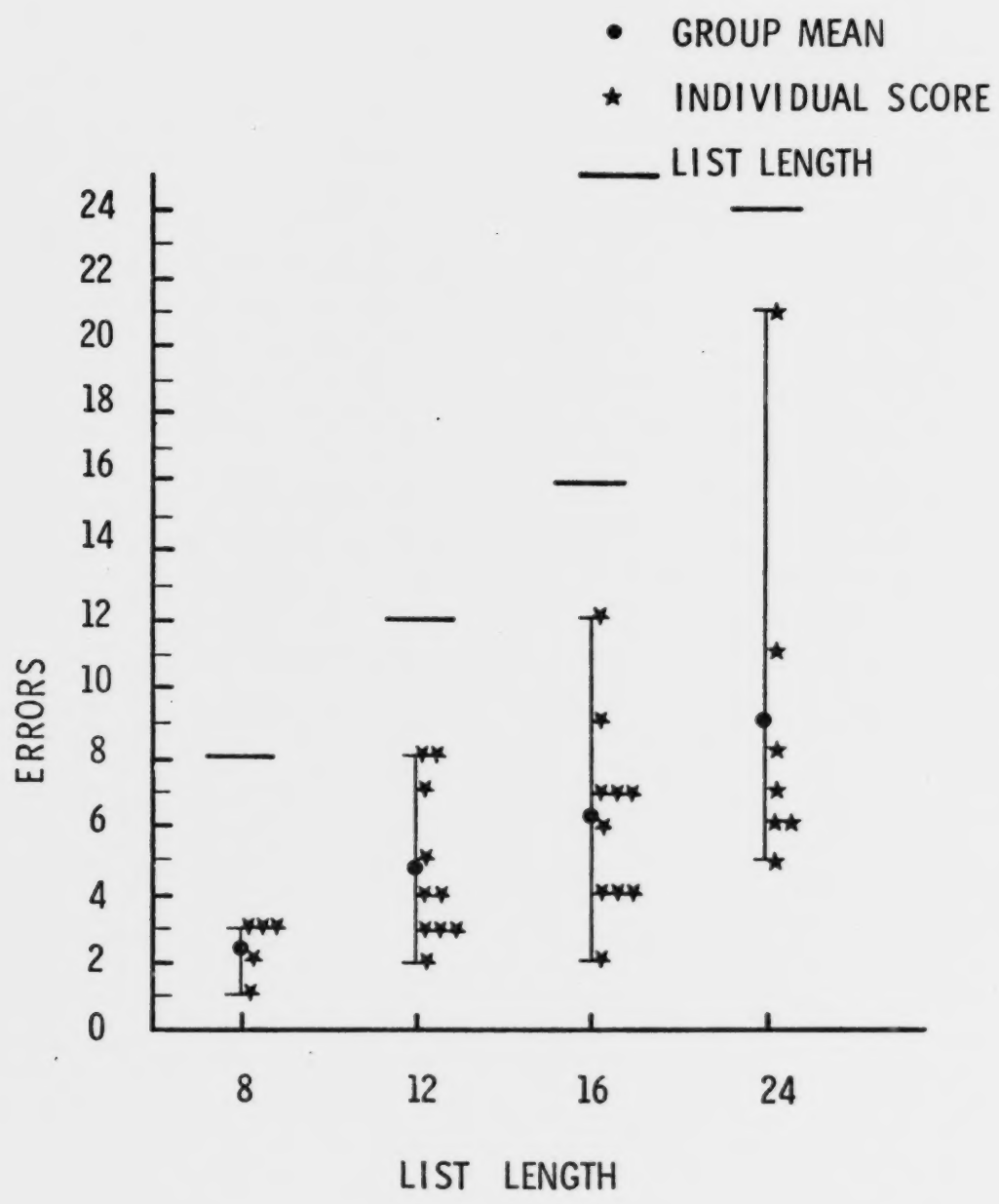


Figure 3

Means Ranges and Distributions of Error Scores

in Semantic Paragraph Condition

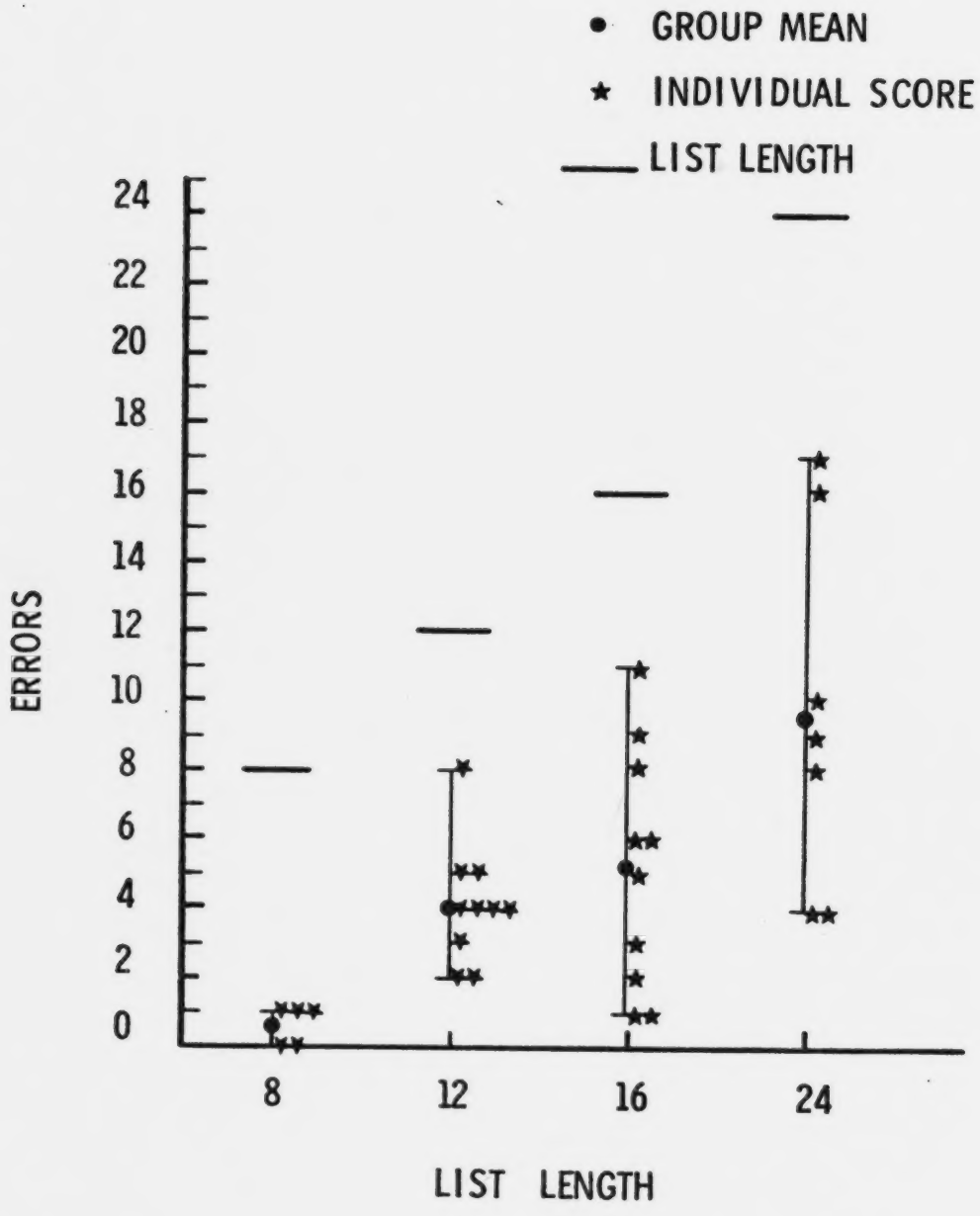


Figure 4

Means, Ranges and Distributions of Error Scores

in Syntactic Paragraph Condition

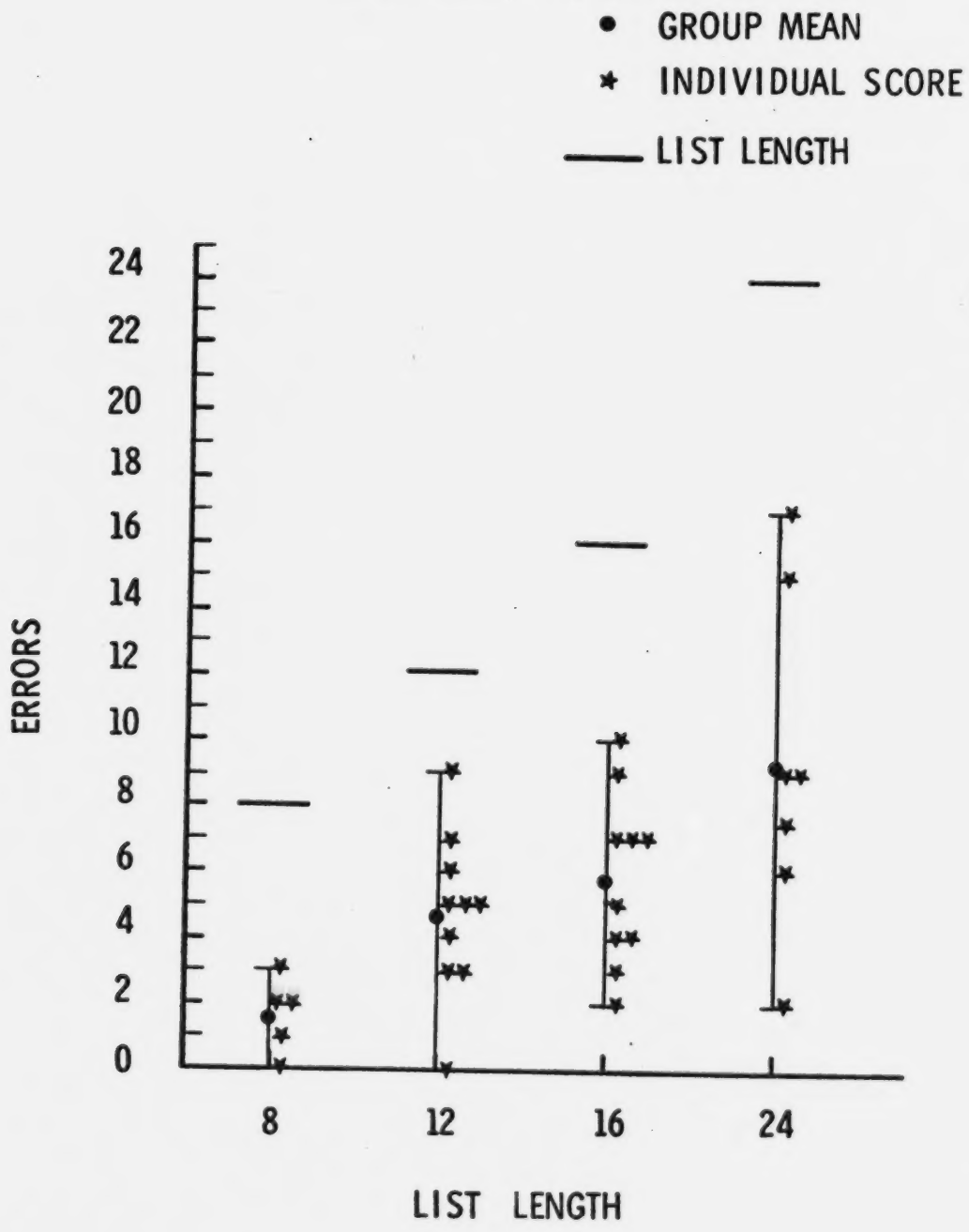


Table 6

Percentage of Errors Made by the Subject Making the Most Errors in Each Treatment Group

Elaboration Condition	List Length 8	12	16	24
Sentence	37.5%	66.7%	75.0%	87.5%
Semantic Paragraph	12.5%	66.7%	68.8%	70.8%
Syntactic Paragraph	37.5%	75.0%	62.5%	70.8%
Overall	29.2%	69.5%	68.8%	76.4%

Table 7

Means and Standard Deviations of the Percentage of Errors Made in Each Treatment Group by Subjects making Less Than or Equal to 50% Errors

Elaboration Condition	List Length 8	12	16	24
Sentence				
$\bar{X}$	30.0	28.6	32.0	29.8
SD	11.1	8.1	11.8	8.8
N[a]	0.0	30.0	20.0	14.3
Semantic Paragraph				
$\bar{X}$	7.5	30.6	25.0	29.2
SD	6.8	9.2	16.3	11.7
N	0.0	10.0	20.0	28.6
Syntactic Paragraph				
$\bar{X}$	20.0	32.3	30.5	26.7
SD	14.2	15.7	12.2	13.6
N	0.0	20.0	20.0	28.6

[a]N = Percentage of subjects eliminated from original treatment group because they made more than 50% errors.

anywhere near as badly as those worst subjects just described is quite small. We see that only from 10 to 30 percent of the subjects in any group (from 1 to 3 individuals) made more than 50% errors at the longer list lengths. Also notable in Table 7 is the fact that the mean percentage of errors made by the remaining subjects (except in the 8-pair, Semantic Paragraph condition) was fairly constant at just under 30%, fluctuating slightly between 25 and 32 percent. Table 8 presents the data on the individuals achieving the best performance score in each group. In general, the best performing subjects in the paragraph conditions made a smaller percentage of errors than similar subjects in the sentence condition. This superiority of one of the subjects in the paragraph conditions to the best performing subject in the sentence condition is always evident when the comparison is made within list lengths, and is surprisingly frequent when made across list lengths (say from the 24-pair, Syntactic Paragraph condition to the 8-pair Sentence condition).

In summary then, the performance of the majority of the mentally retarded subjects studied under conditions approaching quite taxing levels of task difficulty could only be characterized as quite good, and in a fair number of cases, as exceptional. Normal children, especially of the same MA, could hardly be expected to do better, although in some respects they might.

Table 8

Percentage of Errors Made by the Subject Making the Least Errors in Each Treatment Group

Elaboration Condition	List Length 8	12	16	24
Sentence	12.5%	16.7%	12.5%	20.8%
Semantic Paragraph	0%	16.7%	6.2%	16.7%
Syntactic Paragraph	0%	0%	12.5%	8.3%

In particular, one would expect to find even smaller proportions of normal subject samples performing "badly" (i.e., beyond the 50% error level) than was found in the present sample of retarded children. This expectation is based on the commonly observed heterogeniety of subject characteristics in samples of retardates. With regard to this, there is the higher probability that the present sample of retarded subjects contained some children with minimal brain-damage or other neurological defects. This possibility becomes of particular concern since previous research (Turnure, Larsen, & Thurlow, 1971) has shown the possible existence of a relation between brain-damage and poor acquisition on the type of task used in the present study. Although there is a paucity of information in school records regarding possible neurological impairments in the children tested, it seems plausible to assume that proportionately more retarded children than normal children may be brain-damaged. Thus, some consideration should be given to the argument that a 30% error rate (discussed above as characteristic of the majority of the retarded children studied) would be more reasonable as a general estimate to use in subsequent comparisons with groups of normal children than would the overall observed mean error rate of 40% errors. In addition, it seems that much greater attention should be given to the individual performance scores of retarded individuals, whether or not comparative designs are used (cf. Haywood, 1970;

Heal, 1970).

The finding that the subjects in this study performed quite well, even when the language tasks employed were quite taxing, may have important implications for the education of the retarded child. The important variable in learning to associate items appears to be the meaningfulness of the relationships which are formed between the items, rather than the mere extension of the context used to relate them. Although it appears that paragraphs provide little benefit beyond the effects of sentences in more difficult paired-associate tasks (i.e., at longer list lengths), their usefulness in other tasks must not be dismissed without further research. Even though the additional context provided by extended forms of elaboration appears to provide little additional benefit in relatively immediate recall tasks, it may be of value in promoting long-term retention and transfer abilities in the educable mentally retarded.

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Appendix 1

Stimulus-Response Pairs, Their Verbal Elaborators, and the Percentage of Subjects Erring on Each Pair

1. Cup - Soap

   a. Sentence: Wash the cup with soap. (34.4%, N = 32)
   b. Semantic Paragraph: Wash the cup with soap. It is very dirty. (31.2%, N = 32)
   c. Syntactic Paragraph: The cup is dirty. Wash it with soap. (34.4%, N = 32)

2. Wagon - Doll

   a. Sentence: The wagon has a doll in it. (18.8%, N = 32)
   b. Semantic Paragraph: The wagon has a doll in it. She sees it. (15.6%, N = 32)
   c. Syntactic Paragraph: She is pulling the wagon. It has a doll in it. (6.2%, N = 32)

3. Shoes - Boat

   a. Sentence: Why did he throw this shoes at the boat? (59.4%, N = 32)
   b. Semantic Paragraph: Why did he throw his shoes at the boat? It will sink. (46.9%, N = 32)
   c. Syntactic Paragraph: What did he do with his shoes? He threw them at the boat. (62.5%, N = 32)

4. Hat - Lamp

   a. Sentence: Why is his hat on the lamp? (34.4%, N = 32)
   b. Semantic Paragraph: Why is his hat on the lamp? He doesn't want ot wear it. (25.0%, N = 32)
   c. Syntactic Paragraph: Where is his hat? It is on the lamp. (34.4%, N = 32)

5. Telephone - Window

   a. Sentence: The telephone is by the window. (28.1%, N = 32)
   b. Semantic Paragraph: The telephone is by the window. Can you hear it ringing? (28.1%, N = 32)
   c. Syntactic Paragraph: The telephone is ringing. It is by the window. (25.0%, N = 32)

6. Pencil - Hammer

   a. Sentence: Hit the pencil with the hammer. (43.8%, N = 32)
   b. Semantic Paragraph: He hit the pencil with the hammer. Now it is broken. (18.8%, N = 32)
   c. Syntactic Paragraph: What happened to the pencil? He broke it with the hammer. (40.6%, N = 32)

7. Cat - Box

   a. Sentence: The cat played with the box. (62.5%, N = 32)
   b. Semantic Paragraph: The cat is looking at the box. He wants to play with it. (46.9%, N = 32)
   c. Syntactic Paragraph: The cat wants to play. He sees the box. (37.5%, N = 32)

8. Ball - Table

   a. Sentence: Why is the ball on the table? (37.5%, N = 32)
   b. Semantic Paragraph: Put the ball on the table. Don't bounce it. (31.2%, N = 32)
   c. Syntactic Paragraph: Don't bounce the ball. Put it on the table. (34.4%, N = 32)

9. Boots - Monkey

   a. Sentence: Put the boots on the monkey. (29.6%, N = 27)
   b. Semantic Paragraph: Put the boots on the monkey. he will wear them. (25.9%, N = 27)
   c. Syntactic Paragraph: Where are the boots? The monkey is wearing them. (44.4%, N = 27)

10. Duck - Bell

   a. Sentence: Why is the duck under the bell? (92.6%, N = 27)
   b. Semantic Paragraph: The duck is under the bell. It is ringing (88.9%, N = 27)
   c. Syntactic Paragraph: Look at the duck. He is under the bell. (88.9%, N = 27)

11. Carrots - Gate

   a. Sentence: The carrots are growing by the gate. (7.4%, N = 27)
   b. Semantic Paragraph: The carrots are growing by the gate. Did you pick one? (14.8%, N = 27)
   c. Syntactic Paragraph: Here are some carrots. They are growing by the gate. (37.0%, N = 27)

12. Turtle - Chair

    a. Sentence: Stop the turtle from going under the chair. (22.2%, N = 27)
    b. Semantic Paragraph: The turtle is going under the chair. Stop him. (11.1%, N = 27)
    c. Syntactic Paragraph: Stop the turtle. He is going under the chair. (18.5%, N = 27)

13. Dog - Kite

    a. Sentence: Watch the dog chasing the kite. (52.9%, N = 17)
    b. Semantic Paragraph: The dog is chasing the kite. He can't catch it. (64.7%, N = 17)
    c. Syntactic Paragraph: Watch the dog. He is chasing the kite. (47.0%, N = 17)

14. Pig - Clock

    a. Sentence: Did you see the pig looking at the clock? (82.4%, N = 17)
    b. Semantic Paragraph: Why is the pig looking at the clock? It is ticking. (70.6%, N = 17)
    c. Syntactic Paragraph: What is the pig looking at? It is a clock. (70.6%, N = 17)

15. Jacket - Donuts

    a. Sentence: The jacket is hiding the donuts. (5.9%, N = 17)
    b. Semantic Paragraph: The jacket is hiding the donuts. Don't eat any. (5.9%, N = 17)
    c. Syntactic Paragraph: Something is hidden under the jacket. It is donuts. (11.8%, N = 17)

16. Wheel - Barn

    a. Sentence: Put the wheel in the barn. (23.5%, N = 17)
    b. Semantic Paragraph: The wheel is in the barn. Show it to them. (17.6%, N = 17)
    c. Syntactic Paragraph: Bring me the wheel. It is in the barn. (5.9%, N = 17)

Additional pairs used in 24-pair list (see Appendix 2)

1. Sun - Pie

    a. Sentence: The sun is shining on the pie. (28.6%, N = 7)
    b. Semantic Paragraph: The sun is shining on the pie. It will get warm. (42.9%, N = 7)
    c. Syntactic Paragraph: The sun is bright. It is shining on the pie. (14.3%, N = 7)

2. Book - Key

   a. Sentence: The book has a key in it. (14.3%, N = 7)
   b. Semantic Paragraph: The book has a key in it. It isn't mine. (28.6%, N = 7)
   c. Syntactic Paragraph: He has something in his book. It is a key. (42.9%, N = 7)

3. Socks - Bed

   a. Sentence: His socks fell under the bed. (0%, N = 7)
   b. Semantic Paragraph: His socks fell under the bed. He can't find them. (42.9%, N = 7)
   c. Syntactic Paragraph: He lost his socks. They fell under the bed. (14.3%, N = 7)

4. Toaster - House

   a. Sentence: Why isn't the toaster in the house? (0%, N = 7)
   b. Semantic Paragraph: The toaster is in the house. Can you find it for her? (28.6%, N = 7)
   c. Syntactic Paragraph: Where is the toaster? It is in the house. (0%, N = 7)

5. Leaf - Tent

   a. Sentence: Stop the leaf from blowing into the tent. (42.9%, N = 7)
   b. Semantic Paragraph: The leaf blew into the tent. Take it out. (28.6%, N = 7)
   c. Syntactic Paragraph: The leaf is blowing. Stop it from going into the tent. (28.6%, N = 7)

6. Basket - Fish

   a. Sentence: The basket has a fish in it. (57.1%, N = 7)
   b. Semantic Paragraph: The basket has a fish in it. It is in some water. (28.6%, N = 7)
   c. Syntactic Paragraph: The basket has something in it. It is a fish. (51.1%, N = 7)

7. Shovel - Comb

   a. Sentence: He picked up the shovel and found his comb. (28.6%, N = 7)
   b. Semantic Paragraph: He picked up the shovel and found his comb. He had dropped it. (28.6%, N = 7)
   c. Syntactic Paragraph: They found something in his shovel. It was a comb. (42.9%, N = 7)

8. Milk - Saw

   a. Sentence: They spilled milk on the saw. (14.3%, N = 7)
   b. Semantic Paragraph: They spilled milk on the saw. Now it isn't sharp. (28.6%, N = 7)
   c. Syntactic Paragraph: They spilled the milk. It fell on the saw. (28.6%, N = 7)

Mean Number of Words in Elaborators Received by Each Treatment Group

Elaboration Condition	List Length 8	12	16	24
Sentence	6.6	6.8	6.8	6.9
Semantic Paragraph	11.0	10.6	10.4	10.6
Syntactic Paragraph	9.9	9.7	9.5	9.6

Appendix 2

Supplementary Study

A supplementary study was carried out with 24 pairs in order to examine the trends suggested by the data of the original study. Specifically, the effects of the three elaboration conditions were tested in a list of 24 pairs to assess (1) the finding that with longer list lengths, the elaboration conditions did not have differential effects on performance, and (2) the almost asymptotic level of 60% correct responses which occurred for all conditions at longer list lengths.

Method

Subjects. Twenty-one educable mentally retarded children from two of the five schools used in the original study were employed as subjects. These subjects were roughly equated for IQ, CA and MA, and then were randomly assigned to the three elaboration conditions. Because of the limited number of subjects available with characteristics comparable to those of subjects in the original study, the mean IQ's, CA's, and MA's of the subjects in the present study are higher than in the original study (see Table 1A).

Materials. The stimulus materials used in the present study were similar to those employed in the original study. In addition to the pairs used in the 16-pair list of the original study, eight pairs were selected to make up a list of 24

Table 1A

Means and Standard Deviations of Intelligence Quotients, Chronological Ages, and Mental Ages for each Treatment Group in Supplementary Study

Treatment Group	IQ	CA (in months)	MA (in months)
Sentence			
$\bar{X}$	76.0	140.9	105.3
SD	4.6	9.1	5.2
Semantic Paragraph			
$\bar{X}$	75.6	142.9	105.9
SD	5.9	7.6	7.2
Syntactic Paragraph			
$\bar{X}$	76.3	133.1	101.1
SD	4.4	15.3	9.9

pairs. Elaborators for these pairs were constructed in the same manner as in the original study, again with the number of declaratives, imperatives, and interrogatives balanced within each condition. The additional eight pairs and their elaborators are given in Appendix 1.

Procedure. Experimental procedures in the present study were essentially the same as in the original study. The training trial, however, was followed by only one test trial in which the order of presentation was altered to eliminate possible serial learning effects. The number of errors made during this trial was taken as the measure of performance. No reversal trial was given. Again, timing measures were recorded during both the training trial and the test trial with a Rustrak event recorder. Subjects were not asked to recall the elaborators following the test trial.

Results

The mean training trial times in the Sentence, Semantic Paragraph, and Syntactic Paragraph conditions were 15.2, 15.1, and 15.2 seconds, respectively. A one-way analysis of variance revealed no differences among the training trial times for each condition. As in the original study, any differences found between the elaboration conditions in the 24-pair list cannot be attributed to differences in training trial times.

Computation of the mean number of errors made in each condition, however, revealed very little difference between the three conditions. The means for the number of errors made during the test trial were: Sentence -- 9.14; Semantic Paragraph -- 9.71; Syntactic Paragraph -- 9.28. An analysis of variance revealed no difference between the three conditions. Once again, performance was maintained at the high level obtained in the original study with the 12- and 16-pair lists. As was noted in the discussion of the original study, there was a wide range in the individual performance levels at the 24-pair list length. With subjects making more than 50% errors eliminated, the mean percentage of errors in the three elaboration conditions was near the level of 30% previously noted. Again, as in the 12- and 16-pair lists, subjects were found to perform extremely well on this relatively taxing task, with one subject (in the Syntactic Paragraph condition) performing most impressively (missing only 2 of the 24 pairs).

The analysis of differences in performance with respect to declarative, imperative, and interrogative elaborators was carried out on all 24 pairs. The percentages of the three sentence-forms responded to incorrectly were 33.8, 38.1, and 48.4, respectively. Tests for differences between related means showed only the declaratives and interrogatives to be significantly different ($t=2.82$; $df=20$; $p<.02$). Again, as in the original study, any interpretation of these results

must be tentative since the sentence-forms were confounded with the word pairs themselves.

Response latencies for correct and overt incorrect responses are shown in Table 2A. Inspection of the latencies for correct responses reveals that all means were below 4.3 seconds. Scoring of the response latency data for all items showed that 87% of all correct responses were given in less than 6.0 seconds. An analysis of variance did not reveal any differences between the times taken to give correct responses for the three elaboration conditions; the same was true for incorrect responses (F's<1).

Discussion

The present study was undertaken with 24 pairs to supplement and extend the findings of the original study. The results appear to provide further support for the trends suggested in the 12- and 16-pair lists of that study. Again, the Sentence, Semantic Paragraph, and Syntactic Paragraph elaboration conditions did not have differential effects. In fact, the number of errors was very similar in the three conditions. Once again, the level of performance was quite high. As in the 12- and 16-pair lists, subjects, on the average, were able to respond correctly to at least 60% of the paired-associate items.

The data regarding the number of errors made for declarative,

Table 2A

Mean Response Latencies (in seconds) for Correct and Incorrect Responses for Three Treatment Groups in Supplementary Study

Treatment Group	Correct Responses	Incorrect Responses
Sentence	4.21	8.74
Semantic Paragraph	3.56	9.10
Syntactic Paragraph	4.17	9.22

imperative, and interrogative elaborators suggests, as in the original study, that pairs related in a question result in more errors than pairs related in a simple declarative elaborator. Again, however, this result is confounded in the present study. Further investigation is needed in which all word pairs are presented in each of the sentence-forms.

As in the original study, the response latency data indicate that mediational processes involved in associating two items that have been connected by an elaborator are relatively rapid. Although the data of Penney, Seim, and Peters (1968) suggested that mediational processes involved in an A-B-C chain may require more than six seconds in mentally retarded children, the present results should lead one to question the applicability of any hypothesis regarding slower mediational processes in retarded children to mediational processes involved in tasks other than the traditional mediational paradigms.

The findings of this supplementary study thus appear to confirm those of the 12- and 16-pair list lengths in the original study. Once again, verbal elaborators seem to provide striking facilitation of the paired-associate performance of educable mentally retarded children, with longer list lengths inflicting almost no relative decrement in performance.

Footnote

[1]This report is based on the first author's masters thesis, conducted under the direction of the second author. Appreciation is extended to Dr. Arthur M. Taylor and Sharon N. Larsen for the important suggestions and criticisms they provided, and to the principals, teachers, and children of the St. Paul public schools for their patient cooperation.